

AMAZON ORIGINAL

THE AERONAUTS

6E Learning by Design Instructional Planning Model

EARTH SPHERES

GRADE LEVEL: 5

OVERVIEW

In this lesson, students will investigate Earth systems by making observations locally and identifying systems in the natural world. Students will learn through inquiry how the four spheres on Earth (biosphere, hydrosphere, geosphere and atmosphere) are interconnected.

LEARNING TARGETS

- ❖ Students will be able to describe and cite examples of the interactions among the geosphere, hydrosphere, atmosphere and biosphere.

NEXT GENERATION SCIENCE STANDARDS

Middle School Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.

Assessment Boundary: Assessment does not include the identification and naming of minerals.

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere and/or atmosphere interact.

Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere and biosphere are each a system.

Assessment Boundary: Assessment is limited to the interactions of two systems at a time.

Science and Engineering Practices

Disciplinary Core Ideas

Cross Cutting Concepts

Developing and Using Models

Modeling in 6-8 builds on K-5 experiences and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- ❖ Develop and/or use a model to predict and/or describe phenomena.

MS

ESS2.A: Earth's Materials and Systems
All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and the matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)

Scale, Proportion and Quantity

- ❖ Time, space and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

<p>Constructing Explanations and Designing Solutions</p> <p>Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles and theories.</p> <ul style="list-style-type: none"> Construct an explanation using models or representations. 	<p>Grade 5</p> <p>ESS2.A: Earth Materials and Systems</p> <p>Earth's major systems are the geosphere (solid and molten rock, soil and sediments); the hydrosphere (water and ice); the atmosphere (air); and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)</p> <p>ESS-2.C</p>	<p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.
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ENGAGEMENT

Students will take a nature walk and record observations.



Materials	Procedures	Sample Questions / Teacher Hints
<ul style="list-style-type: none"> Inquiry Journal: Lab sheet 1 Pencil 	<p>Students will begin this lesson taking a nature walk on the school campus (or other local place). Begin by previewing Inquiry Journal Lab sheet 1.</p> <p>As they walk, students will record a minimum of five observations on Lab sheet 1.</p>	<p>Some guiding questions to ask students as they walk and observe:</p> <ul style="list-style-type: none"> What do you see? What is happening outside today? Do you notice anything that can change in nature? Teacher Hints: Point out if the ground is covered with leaves or snow, if you see an insect flying around, if a weed is growing near the sidewalk, etc.

EXPLORATION

Students will consider their nature walk observations and identify interactions.

Materials	Procedures	Sample Questions / Teacher Hints
<ul style="list-style-type: none"> ◆ Inquiry Journal ◆ Completed Lab sheet 1 ◆ Lab sheet 2 	<ul style="list-style-type: none"> ◆ Back in the classroom, share on board for whole class Inquiry Journal: Lab sheet 2 and identify on the diagram the components of Earth systems: <ul style="list-style-type: none"> ◆ Air ◆ Earth materials ◆ Water ◆ Living things ◆ Sun <p>As a class, select one observation made on the nature walk (for example, a butterfly landing on a flower). Model on the board and have students record this observation description on Lab sheet 2.</p> <p><i>Example:</i></p>  <ul style="list-style-type: none"> ◆ Next, model on the board for students and have students circle the most appropriate component of Earth systems that this observation fits into (for example, living things). 	<p>Where did we observe water, earth materials, air, living things, the sun?</p> <p>Teacher Note: The sun is not one of the earth's spheres, but is the energy that drives the connections through the atmosphere, hydrosphere and biosphere</p> <p>Why does the example of a butterfly landing on a flower best fit in the "living things" category?</p> <p>Why does a butterfly land on flowers?</p> <p>How does the butterfly landing on a flower connect to earth materials?</p> <p>Where is the flower growing?</p> <p>Does the flower need air too?</p>

EXPLORATION CONT'D

Materials	Procedures	Sample Questions / Teacher Hints
	<p><i>Example:</i></p>  <ul style="list-style-type: none"> ◆ Challenge students to consider this observation in more detail, and describe how this observation could have interactions among multiple systems. ◆ Model this for students on the board, and have them record in their Inquiry Journals. Draw arrows showing connections within the system. Write notes on the arrows to explain the connection. <p><i>Example:</i></p>  <ul style="list-style-type: none"> ◆ After modeling to the whole group, students will work with a partner to consider another observation in the same way on Lab sheet 3. 	

EXPLANATION

Students will identify Earth's four spheres involved in the nature walk observations, and complete a station activity identifying other examples of how the spheres interact.

Materials	Procedures	Sample Questions / Teacher Hints
<p>Part One:</p> <ul style="list-style-type: none"> Completed Lab sheets 2 and 3 	<ul style="list-style-type: none"> Students will share their completed Lab sheet 3 with the class, discussing what connections they could identify from an observation. Once partners have shared out, identify the names of the earth spheres (atmosphere, geosphere, hydrosphere, biosphere), recording them on Lab sheets 1 and 2 above the name of each component. <p><i>Example:</i></p>	<p>Guide student discussion to an understanding that all of Earth systems are connected in some way. Each part cannot be independent for the system to function.</p> <p>Discuss word parts (prefixes, Latin roots, suffix)</p> <p>Atmo- Geo- Hydro- Bio- -sphere</p> <p>Note: NGSS uses the term “geosphere.” This component may also be referred to as “lithosphere” or “pedosphere.” Students should be introduced to all terms.</p>
<p>Part Two:</p> <ul style="list-style-type: none"> Earth Spheres Station Cards Lab sheet 4 	<p>Students will work with a partner and go on an Earth Spheres Walkabout. Station cards will be posted around the room, and student partners will work to identify which Earth spheres are interacting in each example.</p>	<p>Do the first card together as an example. As students are moving from station to station, do a formative assessment as you listen to the conversations students are having. Are students using correct vocabulary? Do students understand what each sphere includes?</p>

ENGINEER

Students will design a terrarium as a model microsystem to investigate Earth systems, and plan an investigation to omit one sphere and observe what happens.

Materials	Procedures	Sample Questions / Teacher Hints
<ul style="list-style-type: none"> ◆ Lab sheet 5: (Earth System in a Bottle Recipe Card) ◆ Lab sheet 6: Investigation Planning Sheet 	<ul style="list-style-type: none"> ◆ Use the Earth System in a Bottle Recipe Card to prepare for design. www.globe.gov/documents/348830/350113/ElementaryGLOBE_EarthSystemsActivity1_en.pdf ◆ Explain to students they will be using a “microsystem” to investigate earth systems, and the earth spheres, from the perspective of a plant. ◆ Have each group of students follow directions in the recipe card to make one terrarium that has all of the parts of the Earth’s systems. ◆ Then choose a way to exclude one interaction (one earth sphere) from a second terrarium. <p><i>Possible examples:</i></p> <ul style="list-style-type: none"> ◆ No light: Wrap with foil/paper. ◆ No soil: Place a moistened paper towel into the bottom section. ◆ No water: Omit the water. <ul style="list-style-type: none"> ◆ Students will complete Lab sheet 6 and discuss their results with peers. 	<p>What part of the Earth’s spheres does the soil represent? Water? Seed? Air?</p> <p>How does this terrarium act as a model of the Earth?</p> <p>How would you model excluding the hydrosphere from your terrarium?</p>

ENRICH

Students will complete an Earth's Spheres Escape Room, revisit the nature walk in a different season, or create a play or skit.

Materials	Procedures	Sample Questions / Teacher Hints
Option One: Escape Room <ul style="list-style-type: none"> ◆ Prepared Puzzles (two or three of each puzzle depending on class size) ◆ Envelopes ◆ Secret Code graphic organizer 	<ul style="list-style-type: none"> ◆ Put students in groups of two or three. ◆ Place one puzzle in each envelope labeling them 1-7. See Escape Room directions page. ◆ Give each group a different puzzle. ◆ As the group decodes the puzzle, they put the answer on the Secret Code graphic organizer. ◆ If the code is correct, then they are given another envelope with a new puzzle to solve. 	<ul style="list-style-type: none"> ◆ Directions for preparing each puzzle can be found on the directions page. ◆ It is helpful to have several copies of each puzzle so the groups that complete a puzzle can have another puzzle to work on. ◆ It is helpful to set guidelines on how students should alert the teacher that they have a completed puzzle which is ready to be checked, so they can move on to the next puzzle.
Option Two: Revisit the nature walk in a different season	Conduct the nature walk in different seasons and compare observations and interactions.	Would you expect to see the same interactions in nature if we take our nature walk again in a different season?
Option Three: Students create a skit or play	Create a play to show what they have learned about Earth's systems.	

EVALUATION

Students will play a beat-the-clock game to record as many connections between spheres as they can in 30 seconds from photographs, or answer a prompt in a journal.

Option One: Beat the clock! Show students a photograph and ask them to write down as many connections between spheres as they can in 30 seconds.

❖ Use photographs from your schoolyard or choose from photographs provided.

Option Two: Journal: Choose a place or event from the list below. Students consider the interactions between the Earth's spheres, and write a summary about those interactions. They must include at least four interactions.

- ❖ Tropical rainforest canopy
- ❖ Tropical storm or hurricane in Florida
- ❖ Volcano erupting
- ❖ Bighorn sheep migration
- ❖ Earthquake Tsunami

This lesson used the following resources:

<https://pmm.nasa.gov/education/lesson-plans/earth-system-science>

https://www.globe.gov/documents/348830/350113/ElementaryGLOBE_EarthSystemsActivity1_en.pdf

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INQUIRY JOURNAL: EARTH'S SPHERES

NAME: _____ GRADE: _____

NAME: _____

JOURNAL

ENGAGE: TAKE A NATURE WALK

Your task is to walk around and look around you. Remain quiet and respectful of nature and your peers. Record at least 5 observations of nature outside. As you walk, consider the following questions:

- ❖ What do you see?
- ❖ What is happening in nature?
- ❖ What interactions can you observe?
- ❖ Is there anything you see in nature that can change?

OBSERVATIONS:

1.

2.

3.

4.

5.

NAME: _____

JOURNAL

EXPLORE AND EXPLAIN



NAME: _____

JOURNAL

EXPLORE AND EXPLAIN



NAME: _____

JOURNAL

EXPLORE AND EXPLAIN

Earth's Spheres Station Activity

Station cards are posted throughout the classroom. Each card gives a situation where two of Earth's spheres are interacting. Determine which two spheres are connected and interacting at each station. Record the number of the station card in the correct boxes below:

Example: Card 1 says "Wind blows seeds to a new location so a new plant can grow."

Hydrosphere and Geosphere

Geosphere and Biosphere

Atmosphere and Geosphere

Atmosphere and Hydrosphere

Biosphere and Atmosphere

1

Biosphere and Hydrosphere

NAME: _____

JOURNAL

Earth Systems in a Bottle Recipe

Each group will make two ecosystems. All groups will make a miniature landscape of the earth's surface. One group will make a second ecosystem that is a living one part of the earth's systems.



Earth Systems in a Bottle



1. Cut the bottom off of a plastic bottle. Use the bottom section of the structure and create your ground with a landscape.
2. Add about a quarter cup of water and seal the cap with the cap to keep the water from leaking out. If there is still air in the bottle, seal the cap.
3. Place the bottle inside with the bottom of the cap. Use your imagination to build the world you believe the cap surface. Sprinkle a little sand and soil on top of the water and to make them.
4. Place the top section of the structure on top, putting a small plant on the inside and outside so that it is the ground. Make sure the top is not on the water.
5. Seal the top and bottom sections together to create an airtight seal.
6. Add the ecosystem with your group's water and place it in a sunny window to watch a green light of new life.

Experiment

Students groups must add new features to create a new ecosystem from one of the two ecosystems made and are doing.



The light
To observe the ecosystem, place it with a light of that way enough to go around the bottle. Make sure the light is not too bright and the top of the bottle of the bottle.



The soil
Instead of soil, place a small amount of paper or soil in the bottle. Make sure the soil is not too bright and the top of the bottle of the bottle.



The water
Instead of water, place a small amount of water in the bottle. Make sure the water is not too bright and the top of the bottle of the bottle.

NAME: _____

JOURNAL

EARTH SYSTEM IN A BOTTLE STUDENT ACTIVITY SHEET

Date: _____

This terrarium includes:

- ☐ Light
- ☐ Soil
- ☐ Water
- ☐ Seeds/plants
- ☐ Air

Draw what you see in this terrarium.



Write about what you see in this terrarium.

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Spheres Escape Room



- ❖ Make copies of the Secret Code Recording Sheet located below. There are two options to choose from: hints or no hints.
- ❖ Make two or three copies of each puzzle. Laminate if possible. Groups can be working on the same puzzle at the same time. It is helpful to have multiple copies of the puzzles so that there is no wait time for the next puzzle.
- ❖ Use Manilla envelopes and put one puzzle in each envelope.
- ❖ Number each envelope with the corresponding puzzle number.
- ❖ Put students in groups of two or three.
- ❖ Give each group a puzzle and a Secret Code Recording Sheet.
- ❖ Students will complete a puzzle and write the code/answer on the recording sheet.
- ❖ After code/answer is approved by teacher, each group is given a new puzzle.

Puzzle 1

Puzzle 1 is a sign language puzzle. Each envelope will need one alphabet chart and one sign language question. The question states: *Lakes, ponds and rivers are all part of what sphere?* **Hydrosphere**

Puzzle 2

Puzzle 2 is a rebus puzzle. Each envelope needs a copy of the rebus puzzle. When deciphered, the rebus will read: *All living things are part of what sphere?* **Biosphere**

Puzzle 3

Puzzle 3 is a double puzzle. Each envelope needs a copy of the puzzle. Students need to unscramble the four phrases (*geosphere includes rocks and dirt; hydrosphere is water; air is in the atmosphere; biosphere is living things*), record the letters in the circles, and then unscramble the circle letters to uncover the secret word. **Interactions**

Puzzle 4

Puzzle 4 is Snote. Each envelope needs a copy of the Snote and a Post-it Note hint. You can put multiple copies in the envelope so that students do not have to share. There are four hidden words in the Snote (*layer, gases, air, Earth*). Using the hint "What could they mean?" Students should answer **Atmosphere**.



Puzzle 5

Puzzle 5 is pictures and a to-do list. Each envelope needs a set of the six pictures and a to-do list. Students will need to look at the pictures and decide which spheres are interacting in each picture (**lightning**—hydrosphere, atmosphere; **prairie dog**—biosphere, geosphere, atmosphere; **rainy day**—biosphere, hydrosphere, atmosphere; **aeronauts**—biosphere, atmosphere; **daisies**—atmosphere, biosphere, geosphere; **mountains**—geosphere, hydrosphere, atmosphere). Students will then have to tally up the number of times each sphere has an interaction with another. Students then have to list the spheres in alphabetical order and record the tally marks to get a four-digit code: **6433**

Puzzle 6

Puzzle 6 is a secret code. Each envelope needs the secret message and the code key. Students will need to decipher the code. When deciphered, it asks the question: Solid and molten rock, soil, and sediment are all part of what sphere? **Geosphere**

Puzzle 7

Puzzle 7 is scrambled letters. Each envelope needs a copy of the tiles cut apart and laminated if possible, a set of the four pictures, and the note to students. Students will need to unscramble tiles into the four spheres (atmosphere, biosphere, hydrosphere and geosphere). Next, they will need to total the sums for each word (atmosphere-17, biosphere-16, hydrosphere-23 and geosphere-15). Finally, students will need to record the sums of the words using the numbers on the pictures to set the order. They should get an eight-digit number: **23151716**

Spheres - Secret Codes

GROUP MEMBERS: _____

Puzzle 1		Puzzle 5	
Puzzle 2		Puzzle 6	
Puzzle 3		Puzzle 7	
Puzzle 4			

Spheres - Secret Codes

GROUP MEMBERS: _____

Puzzle 1		Puzzle 5	
Puzzle 2		Puzzle 6	
Puzzle 3		Puzzle 7	
Puzzle 4			

Spheres - Secret Codes

GROUP MEMBERS: _____

Puzzle 1	(word)	Puzzle 5	(4-digit code)
Puzzle 2	(word)	Puzzle 6	(word)
Puzzle 3	(word)	Puzzle 7	(8-digit code)
Puzzle 4	(word)		

Spheres - Secret Codes

GROUP MEMBERS: _____

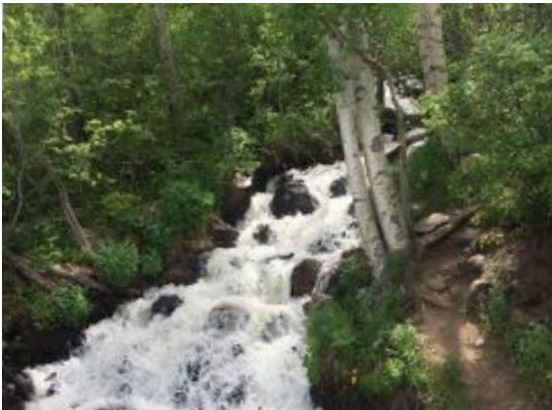
Puzzle 1	(word)	Puzzle 5	(4-digit code)
Puzzle 2	(word)	Puzzle 6	(word)
Puzzle 3	(word)	Puzzle 7	(8-digit code)
Puzzle 4	(word)		













EARTH'S SPHERES STATION CARDS

Print one set of cards for entire class. Spread these cards out and post around the classroom.



CARD 1

**Wind blows seeds
to a new location so
a new plant can grow.**

CARD 2

**A tree's roots go deep
into the ground to support
it so it doesn't fall over.**

CARD 3

**The sun's energy
evaporates water from
a lake, moving the water
molecules into the air.**

CARD 4

**An active volcano
erupts and sends gases
up into the sky.**

CARD 5

**Wind blows down
a palm tree during
a hurricane.**

CARD 6

**A hailstorm
damages an entire crop
of sugarcane.**

EARTH'S SPHERES STATION CARDS

Print one set of cards for entire class. Spread these cards out and post around the classroom.



CARD 7

A small puddle of water seeps into the soil.

CARD 8

The remains of dead plants and animals form coal after being buried under soil over long periods of time.

CARD 9

Soil erosion is lessened by planting trees near a farm field.

9

CARD 10

A heavy rain causes soil to erode into a lake, bringing nutrients with it.

CARD 11

Cloud cover affects the temperature of land.

CARD 12

Plants give off moisture through the process of respiration.

EARTH'S SPHERES STATION CARDS

Print one set of cards for entire class. Spread these cards out and post around the classroom.



CARD 13

Animals breathe in oxygen and breathe out carbon dioxide.

CARD 14

Organisms can only survive in a biome that has the proper air temperature for their adaptations.

CARD 15

Chemicals in the air can impact the rate at which rocks weather.

CARD 16

Flash flooding can carry soil and rocks to new places.

CARD 17

Shifting winds cause precipitation events, affecting the rise and fall of the sea level.

CARD 18

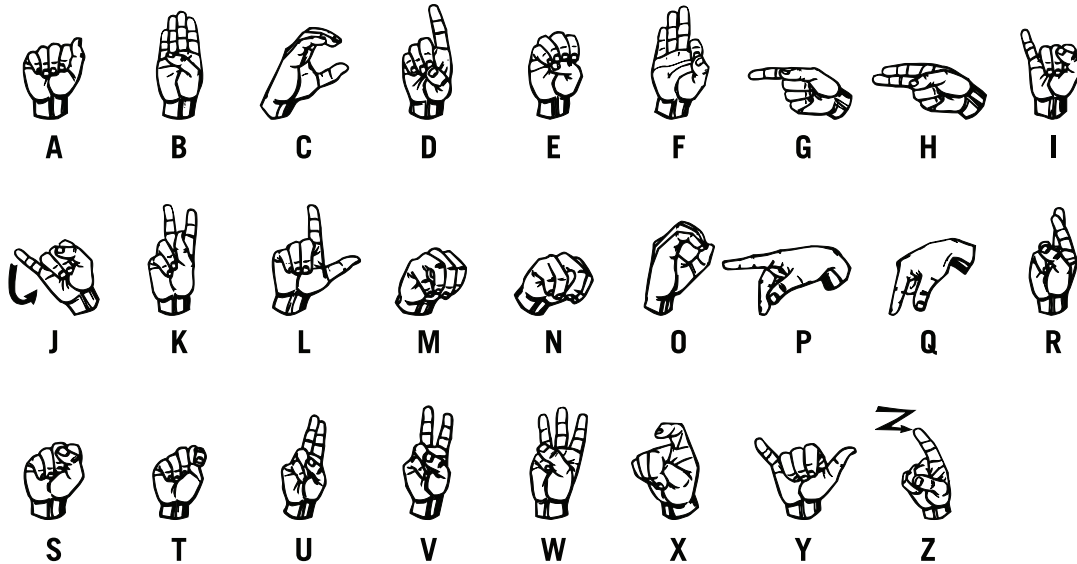
Coral reefs play a role in protecting coastlines by absorbing some energy from the pounding waves.

EARTH'S SPHERES

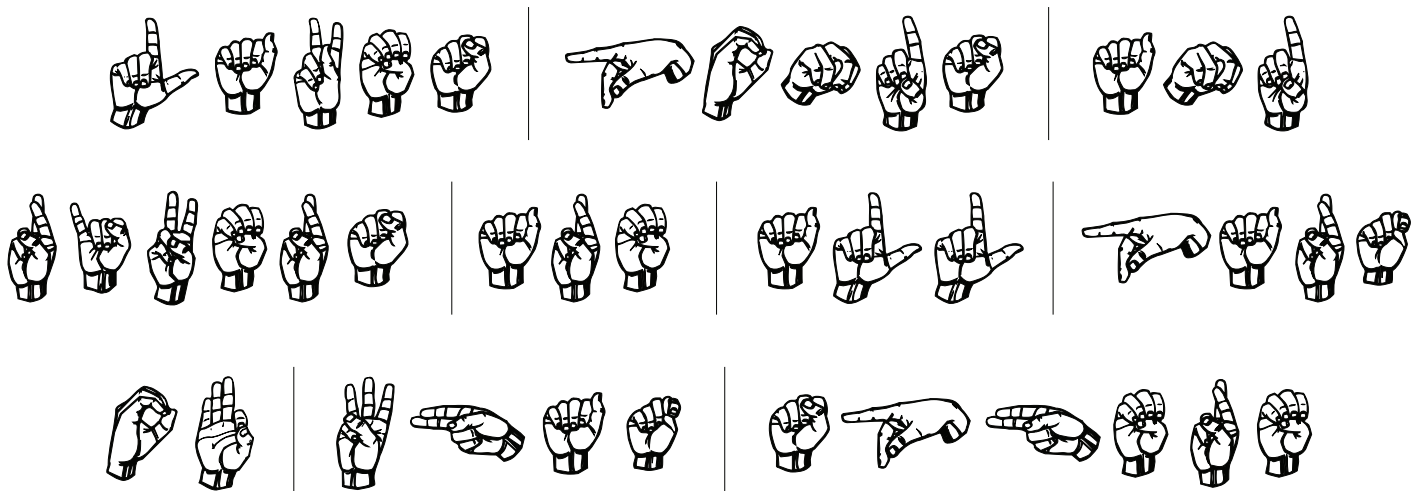
Puzzle 1 is a sign language puzzle. Each envelope will need one alphabet chart and one sign language question.



Use this sign language alphabet chart to decode the question.



Using the sign language alphabet chart provided, decode the question below.



EARTH'S SPHERES

Puzzle 1 is a sign language puzzle. Each envelope will need one alphabet chart and one sign language question.



**LAKES, PONDS, AND
RIVERS ARE ALL PART
OF WHAT SPHERE?**




**LAKES, PONDS, AND
RIVERS ARE ALL PART
OF WHAT SPHERE?**




NAME: _____

Solve the rebus puzzle. Use the line below each box to write the answer.

a+  -be


 -tter+  r=v

t+  r=h+s

 -c+e

 d=p

 x=f

 c=w

 u=s+  -weat+  -ti+?

KEY:



bell

liter

ring

car

dart

ox

chat

up

weather

tie

NAME: _____

PUZZLE 3

Unscramble the four phrases, record the letters in the circles, and then unscramble the circle letters to uncover the secret word.

<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>GOPREHEES</div>	<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>NUSDEILC</div>	<div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>SKCOR</div>	<div><div></div><div></div><div></div><div></div></div> <div>DAN</div>	<div><div></div><div></div><div></div><div></div></div> <div>TIDR</div>
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Using the circled letters (from top left to bottom right) discover the secret word.

EARTH'S SPHERES

Puzzle 4 is Snote. Each envelope needs a copy of the Snote and a Post-it Note hint. You can put multiple copies in the envelope so that students do not have to share. There are four hidden words in the Snote.



*What could
this mean?*

*What could
this mean?*

*What could
this mean?*

*What could
this mean?*

EARTH'S SPHERES

Puzzle 5 is pictures and a to-do list. Each envelope needs a set of the six pictures and a to-do list.



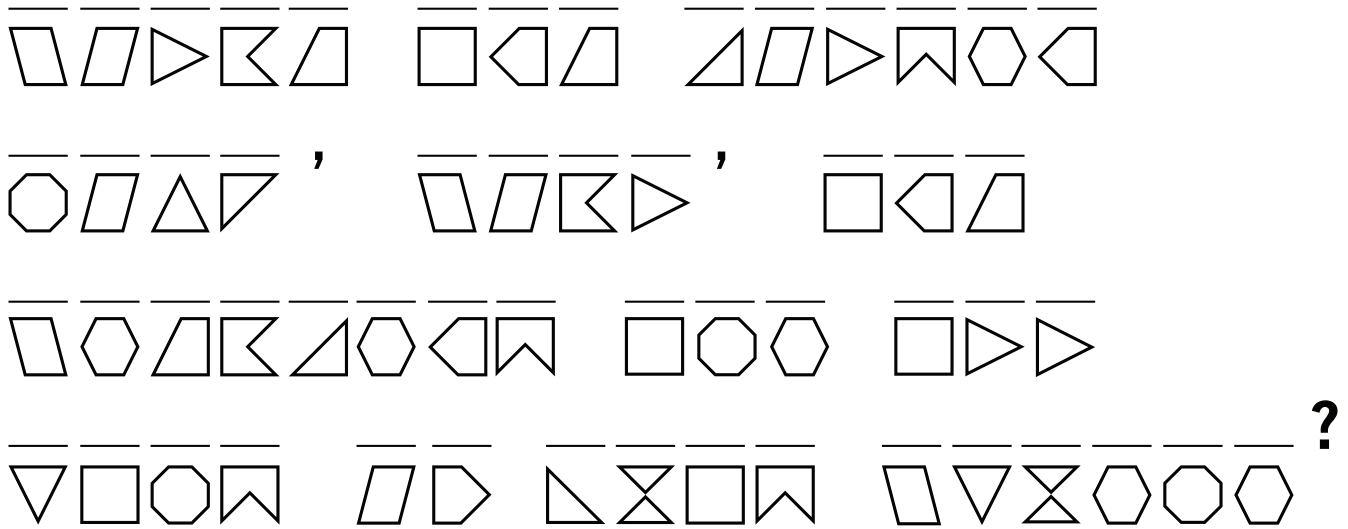
TO DO LIST

- ___ Find the interactions
- ___ Tally the spheres
- ___ Alphabetize
- ___ Record tallies

TO DO LIST

- ___ Find the interactions
- ___ Tally the spheres
- ___ Alphabetize
- ___ Record tallies

NAME: _____

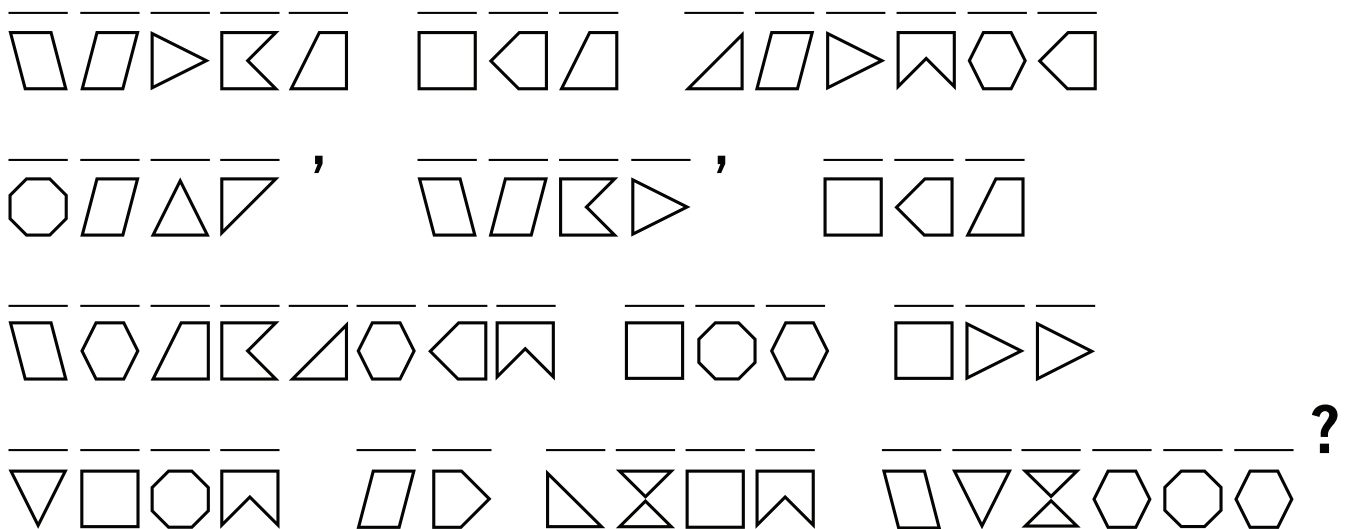


Code Key

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
[square]	[diamond]	[triangle]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]



NAME: _____



Code Key

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
[square]	[diamond]	[triangle]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]	[square]

EARTH'S SPHERES

Puzzle 7 is scrambled letters. Each envelope needs a copy of the tiles cut apart and laminated if possible, a set of the four pictures, and the note to students.

B I O S P H E

R E

G E O S P H E

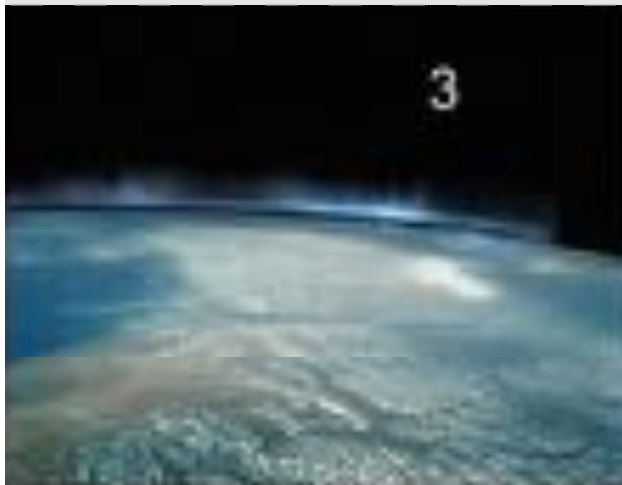
R E

H Y D R O S P

H E R E

A T M O S P H

E R E



Students,

Unscramble the
spheres and record
their sums.
Use the pictures for
clues to order.